OBSERVATIONS DURING THE PERIOD OF UNDERNUTRITION IN GERMANY

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I appreciate most deeply the kind invitation of The New York Academy of Medicine and I did not hesitate a moment in accepting it because I wish to do my best in promoting good understanding between the medical men of the United States and of Germany.

I propose to review the years of undernutrition suffered by the German people during the times of the blockade and revolution and to look on this period not from a political but from a medical standpoint as one would view a great experiment from which we may try to draw some conclusions.

From the very beginning of the war we realized that the available food supply would not be sufficient for the German population because statistics had shown that during the years of peace it was necessary to import many million tons of food for man and cattle and large amounts of fertilizers for the fields. How could the country stand a period of total blockade like a fortress surrounded by enemies on all sides? We therefore were not astonished when we realized early in the Fall of 1914 that the bread supply was insufficient. It was possible to meet this difficulty in two ways. The first was a legally enforced distribution of the entire bread supply to the whole population by means of the bread cards. The second method was a greater utilization of the wheat taken for bread.

The first of these two ways proved beneficial and it was soon necessary to extend the card system with fixed prices to the distribution of meat, milk, eggs, fat, potatoes, and finally to nearly every food-stuff. One may regard a legal distribution of food as a socialistic method but it is necessary to prevent the rich from leading an opulent life while the poor starve as they really did in Constantinople and Vienna. Of course such an enforced restriction and distribution is possible only in a state with strong government and good civil order. With the breakdown of the social order during the revolution of 1918 the regular food supply collapsed and a wild illegal struggle for food began.

The second method of regulation, coarser milling, was of doubtful value. In times of peace the rye and wheat were normally milled so that 60 per cent. was utilized for bread. With the new law it became obligatory to use 95 per cent. so that the bread contained all the bran and this was not digestible for man. This same bran, however, is digestible for the cow and the cow can produce milk from it. Milk almost disappeared from the cities and could only be supplied to infants and sick people. Bread became worse and worse, especially in 1916 when potatoes and turnips were mixed with the whole wheat. The question of the bread was all the more important because, on account of the lack of animal food, bread supplied almost two-thirds of the necessary food calories.

Of all the restrictions the deficiency of *meat* was the least important and produced no bad results. Hyperloyal physicians and men like Ragnar, Berg and Hindhede insisted emphatically that a vegetarian diet would be of the greatest benefit to the population, but more critical observers were not able to see the promised benefits from the lack of meat—with one exception. *Gout* disappeared entirely and in fully developed cases of gout the affected joints showed distinct improvement. Among the population in general the amount of uric acid in urine and blood fell to half of the normal level, not lower. It reached the level of the endogenous uric acid.

Is it not curious that the human body even in restricted diet is able to build up the complicated nucleinic substances while it is absolutely unable to destroy uric acid? Not all of the chemical reactions in the body are reversible.

After the experience of the war there is no more doubt that the development of gouty affections (I do not say the origin of gouty *constitution*), is to a great part dependent on rich food and alcoholic drinks.

The triumph of the vegetarian apostles like Hindhede did not last very long. Soon after the war the whole population forgot the benefactions of the vegetarian diet and eagerly went back to meat—and two years afterward some cases of gout reappeared.

With few exceptions the restriction of diet did not show really bad effects until the Fall of 1916. We all became thinner and

the average weight diminished about 12 per cent. Stout people and heavy eaters lost far more than people of normal shape and it was not rare for the obese to lose 70 to 90 pounds. Real obesity was no more to be seen on the streets and the experience of this period of undernutrition has clearly shown that common obesity is not so much caused by endocrine and constitutional disorders but to a simple discrepancy between food intake and expenditure. The basal metabolism of obese people is not lower than in the individuals of normal shape, but very often a little higher.

Things went on very tolerably until the Fall of 1916. About this period milk disappeared almost completely, cheese, butter and eggs became scarce, bread hardly more deserved its name and worst of all the harvest of potatoes in this year was very bad. Instead of potatoes we were obliged to eat indigestible turnips for breakfast, lunch and supper. The tragedy began. Previously the loss of weight had been due to a diminution of the fat stores but now appeared a wasting of the muscles, and with it came a loss of strength. Exertion grew more and more difficult. In my trips to the numerous hospitals in the field and at home I found it difficult to climb the staircase of railway stations. In the factories they needed three men to accomplish the same work formerly performed by two. Even the children lost the desire to play. In the civil prisons the criminals became so weak that they could no longer work and in the insane asylums patients who formerly were excited remained quiet and stayed all day long in bed since this was the only place they could be warm. The body-temperature was below 96.8° F. and the pulse rate sank from 50 to 40. Even among the population in general, the systolic blood pressure fell to 100 and lower. In addition to the bodily emaciation came a mental exhaustion, depression and irritability, and a large part of the subsequent moral breakdown was due to this state of mind. There was forced upon our notice a mysterious increase in the death rate, particularly among old people. Almshouses and asylums were slowly emptied by the increased mortality and in these houses we first saw the cases of edema. This edematous swelling of face, limbs and body slowly manifested itself among the free populations of the cities also.

In order to explain these problems, experiments were made in many places including our own clinic. Dr. Jansen and I made some observations on the inmates of asylums and prisons and also on some students of medicine in our clinic. All of these persons were put on the diet as prescribed by the legal distribution. First it was necessary to find out the real caloric value of the ration since it would be wrong to estimate its value from the analytical tables used in times of peace. We collected and dried the food for the whole day and analyzed a sample by combustion in a Berthelot bomb. From the caloric value of the food it was necessary to subtract the caloric value of the feces. This examination made it evident that the real caloric value of the diet was not 1,350 calories as officially given, but only 1,100 to 960 calories on account of the large proportion of unabsorbable material. A nutritive value of 1,100 to 960 calories is of course far less than is necessary to maintain the needs of the body. It is even lower than the resting basal metabolism while for light work 2,300 calories at least are necessary. But our subjects were *obliged* to perform some work and muscular work cannot be produced more economically than its real caloric value. And in addition we had to work harder than during the times of peace. It was therefore evident that people on this diet must lose weight and body substance. Examination of the nitrogen content of the *food* showed that the amount of protein in the diet was sufficient and even much higher than the nitrogen minimum of 3 to 4 grams a day, but the nitrogen *excretion* by urine and feces was found even higher than the intake since the sparing effect of the carbohydrates and fats were insufficient.

I cannot understand how Johansson in his latest article could deny the sparing effect of carbohydrates and fats upon the protein metabolism. Did he not realize that this sparing effect is only manifest in cases of *deficiency* and not in cases where carbohydrate is added to a diet that is already sufficient? The negative nitrogen balance in our cases was therefore caused by a deficiency of fat and carbohydrate in the food and as soon as we gave our subjects additional fat or sugar, the nitrogen equilibrium was reestablished and there was even some nitrogen retention.

A determination of the basal metabolism by Zuntz and Loewy and by ourselves made it evident that the basal metabolism was

distinctly diminished in comparison with the metabolism in time of peace and even reduced in a higher degree than the loss of body weight. While the body weight was diminished on the average 10 per cent. the diminution of basal metabolism amounted to from 12 to 15 per cent. These results agree with those of Benedict obtained with his students in the condition of prolonged undernutrition. It was evident that an economical *adaptation* had taken place at a lower nutritive level. In consequence there was a reduction of body temperature, pulse rate and blood pressure and the vitality of other organs with a resulting diminution of mental and bodily efficiency and a diminished resistance against disease. Tuberculosis ran a more malignant course and a frightfully increased mortality,—about 50 to 90%. Pneumonia and other infectious diseases and surgical operations showed a diminished tendency towards recovery.

During the early part of the war some optimistic physicians had published the opinion that the German people had been overfed and that a reduction of food was not only allowable but also beneficial. But when the real diminution in food took place it became clear that it was not a benefit but a menace.

This diminution of the basal metabolism during prolonged undernutrition finds its antithesis in the *increased* metabolism during periods of overabundant feeding. Grafe uses the expression of "Luxuskonsumption," a conception stoutly denied by Karl Voit, Rubner and my former assistant Lauter. It is evident that every increase in the oxidative processes which is not used for muscular work must find its expression in an increased production of heat (I do not say in an increased body temperature). In fact a well-nourished man can bear cold temperatures much easier than a starving man who can scarcely warm himself while in bed, and an overnourished man or animal may even find difficulty in getting rid of his overproduction of heat. But is it really a luxury when the state of nutrition of the body is improved (naturally only to a certain degree) and as a result the resistance against certain diseases is increased? Thus it was possible for me many years ago to show that during the recovery from severe infectious diseases like typhoid fever the basal metabolism was distinctly raised in accordance with the increased

appetite of the patients, and we employ abundant feeding for the curing of tuberculosis. The question of the increased basal metabolism in overnutrition stands in close connection with the specific dynamic action of Rubner and the law of Lavoisier's that the metabolism is increased after the taking of food. The specific dynamic action is only a special case of the general law that food raises and starvation diminishes the production of energy. Rubner has shown that this production of extra energy after taking food cannot be used for the production of muscular work and therefore we may conclude that it does not take place in the muscles but somewhere else, possibly in the liver. Among the different food-stuffs protein produces the most energeric rise in heat production. These are the facts and the only question is how we shall explain the phenomena.

There are three possible ways to explain them. The first and simplest method of explanation is that the human body behaves like a stove and that the more fuel you put in the more is burned, and in consequence the more heat is produced.

The second theory is that food and especially protein act as a stimulus, and Graham Lusk has shown that especially some amino-acids like glycocoll and alanin increase heat production while other amino-acids do not. According to Lusk's work the amino-acids which produce extra heat are nearly the same as those which can be transformed into sugar.

The third way of explanation is that the increase of heat production is due to the work of the intermediary chemical transformations. Thus the transformation of sugar into fat or protein into sugar needs energy and thereby heat may be set free. Included in the work of this intermediary metabolism is the production of hydrochloric acid in the stomach and the work of all the other digestive glands, and I think that they need a lot of energy. I am inclined to propose this last theory. The specific dynamic action is not constant but it is variable and changes not only with the different kinds of food-stuffs but also with the general state of nutrition and especially in connection with the glycogen content of the liver.

The question of overfeeding has been the subject of excellent work by Lusk, who was able to show that in hogs, during a tre-

mendous overfeeding with carbohydrates, a considerable increase of oxidation takes place, the metabolism being increased 100 per cent. above the former basal metabolism, this increase lasting not only twenty-four hours but also during the whole period of overfeeding. But the greater part of the carbohydrate in the food was transformed into fat and deposited in this form in the tissues. The respiratory quotient was increased up to 1.5, although it is only 1.0 during combustion of fat.

The great excess of oxygen output over the intake can only be explained by the transformation of a great amount of carbohydrate into fat, since the molecule of carbohydrate is far more rich in oxygen than that of fat. The enormous increase in the oxidative process may be explained by the assumption that the transformation of carbohydrate into fat requires energy, and the production of this energy proceeds with increased heat production. I therefore believe that the increase in heat production by constant overfeeding can well be compared with the temporary increase of metabolism, caused by the specific dynamic action of foods and that both processes can be explained by an increase in the intermediate chemical work required.

The fourth possibility is put forward by Johansson of Stockholm. A few months ago he published some new ideas about the metabolic processes,—some ideas which may change or alter our previous conceptions. Upon the basis of the researches of Meyerhof and Hill, Johansson has established a theory that the consumption of energy does not take place during the active work of muscles and glands but during the period of *recuperation*—"first the work, secondarily the consumption of energy."

May I make a comparison? Energy is used not in firing the gun but when it is reloaded; not in shooting an arrow, but in drawing the bow. Hill has indeed shown in his splendid experiments that energy consumption, measured in terms of heat exchange, takes place not only during the contraction of the muscle but also—although to a lesser degree—for a certain time afterwards during the period of recovery, and he has shown that this period of recovery is accompanied by an increased consumption of oxygen, which is to say by oxidation.

But I do not believe that it is permissible to draw from this experiment the conclusion that the whole consumption of energy and the whole production of heat fall in fact in the period of recovery, as Johansson wishes to say.

Hill accepts the view of Meyerhof in proposing the theory that during the period of work the glycogen of the muscles is converted into lactic acid and that during the period of recovery the lactic acid is converted back into glycogen. This endothermic reconversion of lactic acid into glycogen requires energy and takes place with consumption of oxygen, but the process takes place without the entrance of oxygen into the molecule, since the relationship between oxygen, carbon, and hydrogen is the same in lactic acid as in glycogen.

The consumption of oxygen and energy must therefore be the consequence of oxidation of other substances. Meyerhof and Hill assume that a part of the lactic acid, either one-fifth or one-fourth, is burned to carbonic acid and water, to provide the energy for the resynthesis of the glycogen, and recently Myerhof has stated that this energy may be produced also by oxidation of fat.

Indeed Zuntz has shown that during a state of glycogen deficiency, work can be produced by oxidation of fat alone, and Lusk has shown in brilliant experiments that in this condition the respiratory quotient is so low as to indicate that the energy production takes place from combustion of fat. Moreover Krogh has shown that the production of energy takes place in a more economical way when carbohydrate is burned than when fat is consumed.

Meyerhof, Hill, and Johansson assume that during work glycogen is transformed into lactic acid, and that during the period of recovery this lactic acid is reconverted into glycogen, only one-fifth or one-fourth of the lactic acid being burned. Within this theory is hidden a little of perpetual motion, and when we assume perpetual motion we are always wrong.

Our acceptance of this theory meets with some difficulties.

First, the oxidation of lactic acid is not so easy as that of the aldehydes, such as methyl glyoxal, glycerol aldehyde, or acedaldehyde.

Secondly, according to this theory we must conclude that an enormous amount of lactic acid is produced in the muscles during hard work. Lusk has calculated that during hard work a man may liberate not less than half a kilo of lactic acid per hour, and in seven hours of hard work might liberate the enormous quantity of 3.5 kilos of lactic acid. Of this amount four-fifths would be resynthesized into glycogen.

Third, Hill himself states that "in a muscle kept in oxygen, no lactic acid ever appears." Lactic acid appears in muscle preparations only when contractions occur in an atmosphere free from oxygen. Lactic acid is therefore found only in the absence of oxygen.

I believe, therefore, that the older assumptions are not yet disproved. The older theory was that the energy of muscular work is produced by direct combustion of glycogen and sugar, with the intermediate products of easily combustible materials such as pyruvic acid, methyl glyoxal, and acetic aldehyde, and that this energy can also be produced by the combustion of fat.

I do not care much which of these theories is right. The facts are established and the experiences during the period of undernutrition have clearly shown that our views about the energy metabolism are right and that they fully agree with the law of the conservation of energy.

After consideration of the *quantitative* metabolism let us turn to the *qualitative* and *pathological* changes seen in men during the period of undernutrition. The most important symptom was the hunger edema with its pale, swollen and mask-like face. One could believe that this pale color was due to a severe degree of anemia, and examination of the blood showed that the red blood cell count was somewhat low but this apparent diminution of the red blood corpuscles was due to a hydremic condition and not to a severe reduction of the red blood cells. The blood serum was indeed very rich in water and the protein content was extremely low, even down to half of the normal rate. The amounts of calcium and lipoid bodies were distinctly lowered. The sugar content varied between very low and nearly normal. On the other hand the sodium chloride was extremely high, even up to 0.8 per cent. We can explain this phenomenon by Donnan's law which states that the content of salts must rise in body fluids when there is a diminution in the protein and other colloid materials. This is necessary in order to maintain the normal osmotic equilibrium. The body tissues as well as the blood serum were overfilled by a fluid which approached the composition of normal physiological salt solution. We can therefore understand the abnormal craving of the patients for salt in the food. With this

the excretion of sodium chloride in the urine increased to as much as 40 grams a day and more. It was evident that the function of the kidney was normal and that the edema was not due to an insufficiency of the renal function but was of extra-renal origin. We may ask if it was the low content of protein in the blood serum which caused the transudation of salt solution into the tissues or if it was the diminution of the calcium and especially the lipoid substances which led to an abnormal permeability of the walls of the blood vessels.

It was interesting to see that the content of hemoglobin in the red blood corpuscles was not diminished but was increased and the color index rose far above 1 and even as high as 1.9. In stained blood smears the red corpuscles showed an appearance similar to that found in pernicious anemia. But this high color index had nothing to do with pernicious anemia and it is evident that we may conclude from this that the high color index is not the essential characteristic of pernicious anemia, but that in this disease other factors are of greater importance.

We have seen that even in severe cases of hunger edema no real anemia was present and as a matter of fact during this period we saw no cases of chlorosis. We can conclude that even during a time of serious lack of food the synthesis of the complicated hemoglobin molecule takes place without difficulty. Apparently living organisms from the yeast cells up through the whole series of animals find no difficulty in producing the complicated nitrogen-containing ring of the substituted pyrrol molecule and from simple open chains combine the coloring matters of porphyrine, chlorophyl and hemoglobin. How extraordinary that the body is not able to break down the once established hematine farther than bile pigment! Therefore here as in the case of the purine metabolism we have an irreversible reaction. My former assistant, Prof. Hans Fischer, in the last few months has had the good fortune to be able to prepare synthetically hematoporphyrine and he pointed out that the production of hemoglobin by animals and man by far exceeds in amount the artificial production of all the paints and dyes of industry.

During the second half of 1917 hunger edema disappeared in a relatively short time. This was the result of a good harvest of

potatoes and these potatoes allowed us to give once more sufficient calories. Potatoes indeed saved the German population from the extremes of starvation.

When a patient with the hunger edema really began to improve there was a tremendous increase in the output of urine. With this came an excretion of as much as 160 grams of sodium chloride in a few days and a rapid loss of weight. In cases where we were able to give abundant food again we saw to our astonishment that the patient did not increase in weight. But we must not forget that he had to replace the water in his tissues with fat and that a kilo of water is as heavy as a kilo of fat and that the same volume of fat tissue is not nearly as heavy as the same volume of salt solution. Therefore the weight of a person is a most uncertain indicator of his state of nutrition.

When we saw the first cases of edema we believed that it was a manifestation of avitaminosis. However the well-established types of avitaminosis did not appear. We never saw diseases like beri-beri or scurvy because we had plenty of potatoes, turnips and other vegetables. But in Asia a part of the English army surrounded by Turkish troops and cut off from all fresh food suffered from a severe outbreak of scurvy.

Are we really to consider hunger edema as a symptom of avitaminosis? This makes it necessary to define what we mean by vitamines.

The characteristic signs of avitaminosis are:—

1. A diminution of fertility.
2. A retardation of development and especially of the growth of young animals and children.
3. Symptoms of malnutrition and disease in the fully developed adults.

Diminished fertility was indeed one of the characteristic symptoms during the period of inanition. The official register showed that the birth rate had diminished enormously, falling to half the figure of the rate before the war. Abortions became frequent, in many young women menstruation ceased and in men there was a marked diminution in the libido. We can see therefore that there was a distinct diminution in the function of the gonads. Zahn has shown by his official statistics that during the war the

diminution in the number of births amounted to the same low figure as if for one whole year there had been no births in Germany.

The worst part of this whole affair was that we looked upon this not as a calamity but as a blessing because we were sure that we would not have either enough food or enough work to maintain them. It is a regulation of nature that in times of want the number of individuals decreases.

But one question. Is the diminution of fertility a characteristic and pathognomonic sign of avitaminosis? I think not.

Professor Stieve in Halle has shown in his experiments on mice, rats and geese that not only inanition but more so overfeeding and obesity checks fertility in both male and female, and brings about severe atrophy of the gonads. Furthermore he could demonstrate that fear, confinement and other severe *mental* influences damaged materially the power of fertility and produced an atrophy of the gonads as demonstrated by the microscope. Therefore we may conclude that the diminution of the birth rate is not a characteristic sign of avitaminosis.

Next we shall consider our second point, the development of children. During the war the increase in weight of children fell off markedly, in Munich 4 per cent., in some other cities as much as 12 per cent. The growth in height was only slightly diminished, ¾ of one per cent. on the average and according to some reports not at all affected.

There was indeed some extension of rickets among the children, especially in Vienna and some other large cities, and during the years of adolescence coxa vara with its characteristic pain became frequent. Older people and hunchbacks complained of pains in the back, X-rays showed slight osteomalacia and kyphosis became worse. Treatment with phosphorus and cod-liver oil brought distinct improvement.

The "Wachstumstrieb," the *impulse* for growth therefore was *not* diminished. The observation of the fact that the affections of the bones improved distinctly after the administration of cod-liver oil could be explained as a symptom of avitaminosis due to deficiency of vitamine A. We must remember that vitamine A is not equivalent to "Wachtumsreiz," the stimulant of growth, but

that this vitamine A is a necessary complement to bring about growth. When there is no stimulus, vitamine A cannot produce growth but growth can be checked by a deficiency of vitamine. The mysterious "Wachstumstrieb," the stimulus for growth is more dependent on the glands of internal secretion like hypophysis, thymus and thyroid gland but it can only act with the help of the vitamines.

Among the vitamines which are necessary for growth vitamine A seems to be the most important. A. F. Hess has shown, and some German investigators have corroborated, that vitamine A does not belong to the phosphatids like lecithin but that it is related to cholesterole and arises from this substance under the influence of light. Windhaus has established the chemical formula of cholesterine. The alcoholic group is the place where it can combine with fatty acids to form esters. We may assume that the double binding is the place where light acts and produces some oxidation. This vitamine is therefore no longer a mysterious body and this helps us perhaps to have a better understanding of the nature of the vitamines in general.

Would it not be possible to characterize the vitamines as all those substances which are necessary for growth and maintenance of health which cannot be produced by the organism itself but must be supplied from outside? I should like to support the old view of Liebig that the soil needs at least a certain minimum of every single substance necessary for the growth of the plant. In the same way it holds true in the animal body that growth is only possible with a minimum of iodine and Halsted has shown that growth is checked when there is no iodine in the food. I therefore conclude that iodine is a vitamine, like calcium, magnesium and iron. Of course growth is not possible without protein but it is not protein itself which is necessary but the single amino-acids. It has been proved that growth is impossible without lysine and the establishment of nitrogen equilibrium and the prevention of death is possible only with a mixture of amino-acids which contains cystine and tryptophane.

Now we come to the question as to whether cholesterole can be formed in the body or if it must be given in the food. Thannhauser has shown in his experiments that the excretion of choles-

terine in urine and feces is nearly the same as the intake in the food. But should we not include in this balance between intake and output the bile acids also, the chemical formula of which is so closely related to that of cholesterole, that we must conclude a common origin? The production of bile acids for twenty-four hours amounts in the dog to one or two grams while the cholesterole in the food is not more than a few milligrams. We may therefore conclude that the complicated formula of cholesterole and bile acids may be combined in the body and Windhaus believes they are built up from the straight chain of oleinic acid.

Pirquet and other authors have assumed that the phosphorus-containing lipoids like lecithin are not among the vitamines, but that they can be produced by the body itself. I am not perfectly sure of it. Why then does the yolk of the hen's egg and of all other eggs contain so large an amount of phosphoric lipoids? It seems to me that they are necessary for the building up of the embryo. On the other hand it is of interest that in the egg neither pyrrol nor purine bodies are present although during the development of the chick within the shell a great amount of blood pigment and nucleinic substances are formed. It is evident that pyrrol and purines do not belong to the vitamine group.

With the end of the war we hoped that the blockade would end and that food supplies would come in again to the starved population. But the blockade continued. The deprivation of food became extreme, the mental state of the population broke down, all bonds of order collapsed and the revolution broke out, with the slogan of "more food, at lower prices, and shorter hours of work." In this worst period of our country the work of charity from America set in and we never will forget our thanks for this help of charity given to the starving German population, by our American friends, especially by the Quakers and last, but not least, by the American physicians.

Gentlemen: I have tried to draw a sad picture of the starvation which the German population suffered during the war. War is bad, it brings enormous sufferings and losses of life and happiness, it disturbs the mind and evokes cruelty. But war is able to bring forward the greatest mobilization of energy, self-denial and sacrifice.

Revolution is worse, it loosens all bonds of authority and releases the lowest instincts in the worst classes of the population. The gain is small and the loss of culture great. The recovery from the false ideas is slow, very slow.

I sincerely hope that your beautiful, rich and highly cultivated country will never undergo the horror of revolution which is the most cruel of all kinds of war.

Abstracts of papers presented before the Section of Genito-Urinary Surgery, March 17th and May 21st, 1926

(a) URIC ACID AND URATIC STONES IN THE KIDNEY; URIC ACID SHOWERS AND DIAGNOSIS

EDWIN BEER

One of the most serious pitfalls in diagnosis encountered by surgeons, internists and radiologists is in the recognition of uric acid stones and the clinical pictures induced by such stones or by showers of uric acid crystals. The clinical pictures presented by the above conditions have interested us for a number of years. Originally, it was recognized that stones of this composition caused no shadow on the X-ray plate, and the report of a negative radiogram was recognized as of but little value. With the introduction of the Bucky diaphragm these uratic stones in the bladder were more regularly caught on the film though the shadow, at best, was only faint. In the upper urinary tract, the analysis of stones passed showed that in this vicinity about eleven (11%) per cent. of the stones were composed of uratic salts and uric acid. These the X-ray regularly failed to show despite the use of the Bucky diaphragm.

In a series of six cases presented at this meeting, it was shown that the diagnosis of the presence of uric acid calculi in the kidney pelvis could be made by combining pyelography and the passage of wax bougies. These stones in the kidney pelvis at times attained large size, and in the pyelogram showed their presence by a well-marked filling defect. Very frequently in